

An Integrated Approach for Assessing Graduate Engineering Management Programs*

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Professional degrees are critical to many universities because of their relevant connections to employers/industry and the ability to provide the university with an additional revenue stream. These programs need to be adaptive and flexible in terms of content and delivery modes and be stakeholder driven with a strong focus on quality, relevancy, and customer satisfaction. This requires a paradigm shift in the assessment philosophy. This paper explores the keys elements of assessment for these executive style programs. The assessment process must focus on both formative and summative assessment for student learning, student satisfaction/value, program delivery, and employers perceived value in addition to the traditional student learning outcomes. We present a case study to demonstrate an integrated assessment approach. We share the details of this integrated approach with the goal that program directors can use this framework or elements of to adapt their current assessment approach.

Keywords: professional programs; formative assessment; summative assessment; assessment

1. Introduction

Few will argue that the landscape of post-secondary education is changing. As shown in the system-igram shown in Fig. 1, which is used to pictorially represent complex problems, much has changed since on-campus programs taught in lecture format was the norm and universities operated on revenue from mainly tuition and government support. With the emergence of online learning, COVID-19, for-profit universities, massive open online courses, professional degrees at the post undergraduate level taught in nontraditional formats, flexible delivery modes, decreased enrollments – especially in more developed countries, etc., universities must evolve and adapt to market forces to remain not only relevant but also financially viable. Programs need to be adaptive and flexible in terms of not only content but delivery modes. Professional degrees are especially susceptible to these market forces because of their customer focus and nontraditional legacy. The main focus of professional degrees is the real-world application of the material. Often theory is replaced by real-world problem solving and a focus on productivity. Whereas historically master's degree focuses on gaining a deeper content knowledge and/or research experience within a specific discipline.

Modern graduate professional degree programs must be stakeholder driven and delivered with a

focus on quality, relevancy, and customer satisfaction. Often, these professional students must be treated like any customer procuring either products and/or services. However, this requires a paradigm shift in terms of assessment philosophy from the traditional student learning outcomes focus. Like many of the products/companies that were replaced by disruptive technologies, professional programs must be adaptive and customer driven or they will eventually become irrelevant and lose market share or be displaced. In some respects, this is already starting to occur with companies like Coursera and Udacity, for profit universities, continuing education organizations within traditional universities that is a separate entity from traditional academics, etc. Many universities have separated out these types of programs in order to market them to the working professional with the explicit goal of “keeping their employees current with the latest knowledge, tools, and processes.” A more robust assessment philosophy is needed for these types of programs because of the multitude of customers or stakeholders. Also, the target customers are more demanding than a traditional graduate student where customer service is vital, see little value in standardize testing for admission, and relevance is paramount. Many of these program charge tuition rates significantly above the traditional on campus programs. In reality, not only professional programs, but all of academics needs to embrace a

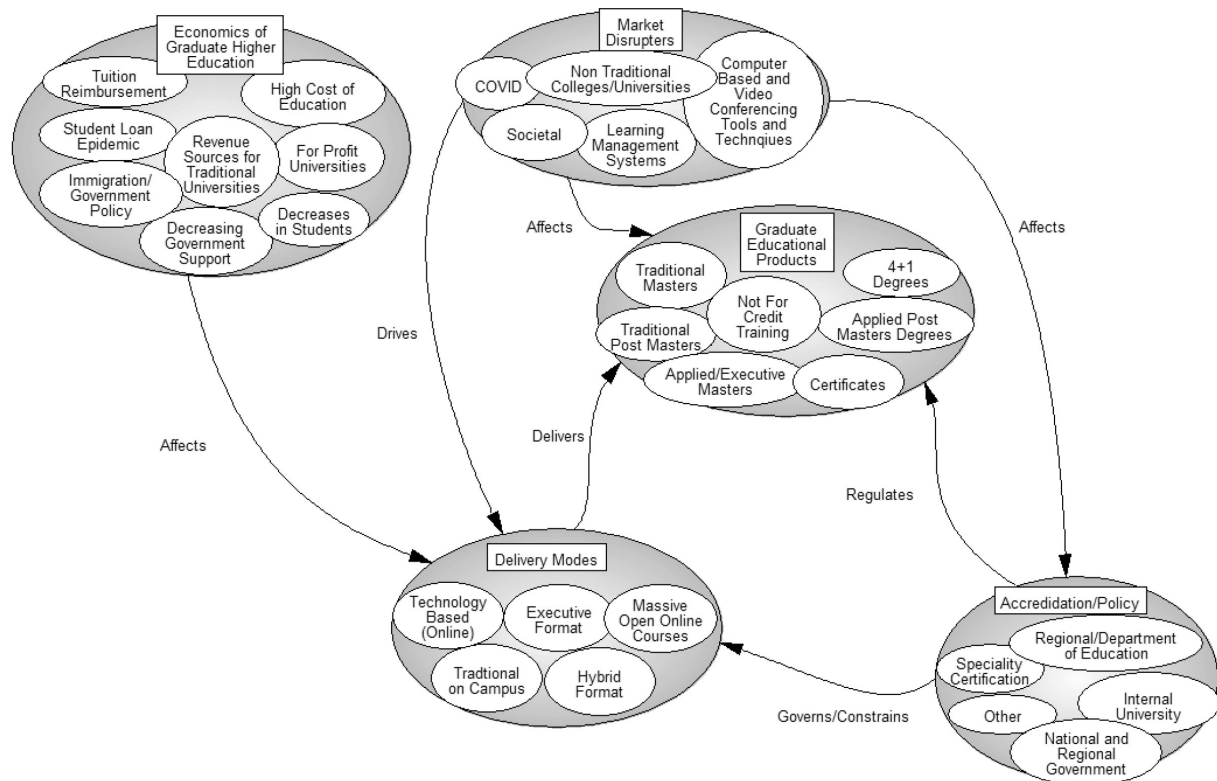


Fig. 1. Systemigram of the complexity associated with modern graduate education.

different assessment philosophy because of market forces. We need to deemphasize the learning outcomes/objectives driven philosophies and focus more energy on stakeholder value.

Accreditation societies such as ABET, regional, government, etc., accreditors have recognized the need for a customer focus. For example, [1] engineering criteria states that “The program must have published program educational objectives that are consistent with the mission of the institution, the needs of the program’s various constituencies, and these criteria. There must be a documented, systematically utilized, and effective process, involving program constituencies, for the periodic review of these program educational objectives that ensures they remain consistent with the institutional mission, the program’s constituents’ needs, and these criteria.”

According to [2] between the fall of 2009 and 2019 undergraduate enrollments decreased by 5% in the United States (US). During that same period average post-baccalaureate enrollments increased 8% with public schools increasing by 5%, private non-profits by 14% and for profits schools saw a decrease in enrolment of 14%. According to the National Science Foundation [3], science and engineering graduate enrollments grew 35% from 2000 to 2015 in the US. That same reference also stated that only about 24% of the graduate degrees are pursuing a degree right after completion of their undergraduate

degree in the US. Thus, a high percentage are post baccalaureate students who are working professionals. Many of these students are pursuing professional programs while working full time.

2. Program Assessment – A Summary of the Literature

To help design, execute, and reflect an integrated assessment process we conducted a review of the literature of the six proposed components of the assessment process.

1. **Focus on both formative and summative assessment.** Formative assessment is a feedback process used by students and instructors to measure student learning outcomes, such as in-class exercises, reading reflections, group project presentations, and “come-in” and “leaving with” papers. Summative assessment is to evaluate individual course and overall program outcomes in order to improve content and instruction for each course as well as for the overall program. It involves such tools as course evaluation survey, program assessment survey, Start-Stop-Continue class discussions, alumni and sponsors surveys, and end-of-cohort brainstorming sessions with faculty and admin. The literature [4] stated that both

- formative and summative assessment tools must measure at least three students' outcomes: (1) knowledge (theoretical understanding and practical application), (2) skills (problem solving, analytical skill, and communication), and (3) competency (autonomy and responsibility). Damaj, et al [5] also concluded that not only knowledge, but skills and behavior need to be assessed with a focus on life-long learning in order to properly assess a program quality.
2. **Use multiple assessment tools.** Program assessment should be a systematic process that involves data collection about topics of interests for enhancing understanding and judgement to effectively use resources [6]. Goldstein [7] defined assessment as "the systematic collection of descriptive and judgmental information necessary to make effective decisions related to the selection, adoption, value, and modification of various instructional activities". In order to obtain meaningful data about an educational program, the assessment process must include both formative (i.e., measuring student's learning) and summative (i.e., identifying course and overall program content opportunity) tools [8]. However, the authors also recognize that the most common and used assessment tool is the end-of-course student evaluation and that additional assessment methods should be added to fully evaluate a program effectiveness. This conclusion is also supported in other articles in the literature. Felder, et al. [9] stressed the importance of student self-evaluations as well as learning logs and journals (i.e., course session takeaways) as additional assessment tools to be used to evaluate a program quality. Cruz, et al. [10] also included assessment tools such as rubrics, tests, observations, interviews, and reflections.
 3. **Understand the longitudinal impacts of the program by measuring before, during, and after the program.** Students should begin the program assessment process as soon as they start the program to measure their learning outcomes throughout the length of the program [11]. Purzer, et al. [12], in addition to using multiple triangulation tools to program assessment, also pointed out the importance to assess the program long-term results, past the graduation day. Landaeta [13] also confirmed the need to measure the different levels of learning complexity based on various learning aspects as program impact assessment needs to cover multiple dimensions of learning. There is a need for a more vigorous approach that considers the main aspects of a program assessment during the program life cycle.
 4. **Involve multiple stakeholders.** For traditional academic programs, multiple assessment tools need to be used for an effective program evaluation, but multiple participants must also contribute to the process; self and tutor/professor assessments are warranted [14]. This paper will argue that employers/sponsors and alumni need to be involved in the program assessment result analysis to further improve the program quality.
 5. **Ensure the assessment results are deployed for continuous improvement.** Although multiple assessment techniques have been developed over the years [12] another issue with program assessment that needs to be addressed is that too many times, when assessments are used in a program, the results are not analyzed and applied to fully solve rooted problems affecting potential student learning [15]. No follow up is looked at to improve program content and the assessment results are just filed for administrative purposes. While many evaluation tools are available, little emphasis is focused on how the results can be used to improve program quality [16]. Furthermore, some have even compared the use of assessments as mostly a mechanical "ritual" [17] without any further actions. Nonetheless, the Engineering Accreditation Commission of ABET with the Engineering Criteria 2000 required that assessment results be utilized to improve program quality. Therefore, each program should not only conduct multiple assessments to measure students learning and program excellence level but should also be used to further develop and grow the quality of the program.
 6. **Provide evidence to employers and prospective students of the program's value.** The need for systematic, repeatable, and sustainable program assessment tools is underlined by what Phillips and Phillips [18] describe as: (1) the need of executives and managers who are sponsoring the employees to attend the program, to understand the use and results of the funds they allocate, and how the program intent contributes to the organization's strategy; (2) the distribution of scarce organizational resources among different competing educational programs; and (3) the perceived inability of the university-based programs to deliver the expected results. The American Society for Training and Development [19] stated that in 2007 organizations in the US spent approximately \$134B on employee learning and development. Therefore, the need to evaluate the effectiveness or the return on investment of professional programs offered

to organizations' employees must be addressed to justify these program existences.

We will present a case study demonstrating program assessment process of these six components. This assessment process measures students' learning and program effectiveness from a multi-dimensional perspective, with many assessment tools, over the program lifecycle and beyond, from all program stakeholders.

3. Case Study

We use a case study to demonstrate a program assessment process using the above six components. The intent of this case study is to learn from an application of the principles identified in the literature review. Every class, program, and university are unique. No one assessment process fits all. Often assessments evolve over time because of increased requirements from accreditors, the university, government, or simply continuous process improvement. We believe that element of the general framework presented in the previous section can be applied/adapted to any educational program. The specific questions a program may need to answer for their assessment process includes:

- How do we build an assessment process that is aligned with the program's desired outcomes?
- How can we balance both formative and summative assessment?
- How can we build process that is sustainable and all stakeholders understand its value?

3.1 Case Study Overview

Having a multi-faceted assessment methodology is not new. The training community has well devel-

oped models [20, 21] that are used by training practitioners. Using a meta-analysis of 397 reports within the training and development literature that was published between 1960 and 2000, Arthur et al. [22] the following distribution of reports per level of program assessment: reaction (4%), learning (59%), behavior (31%), and results (7%).

This paper presents a case study using a non-traditional program in engineering management (EM) that implemented this type of assessment methodology as part of continuous process improvement. We will present data instruments and lessons learned for a Professional Project and Systems Engineering (PP&SE) degree that is part of Masters of Science on Engineering Management (MSEM) at the University of Central Florida (UCF), US. The university offers both a traditional EM and this professional master's degree in a cohort format. This cohort program is delivered in multiple day long lectures supplemented with some online content. The cohort program is focused on the working professional with at least five years of professional experience. The overall intent/mission of the program is to increase the student's ability to lead a project team and identify and deliver an innovative solution that is cost effective, value driven, on time, and strategically important. The intended participant is the technical individual contributor who is becoming a technical team leader or project manager. We identified five characteristics shown in Fig. 2 of a professional graduate program that give it relevancy, value and identity and drove our concept of operations and assessment philosophy.

3.2 Integrated Assessment Approach

We applied the framework to the UCF program

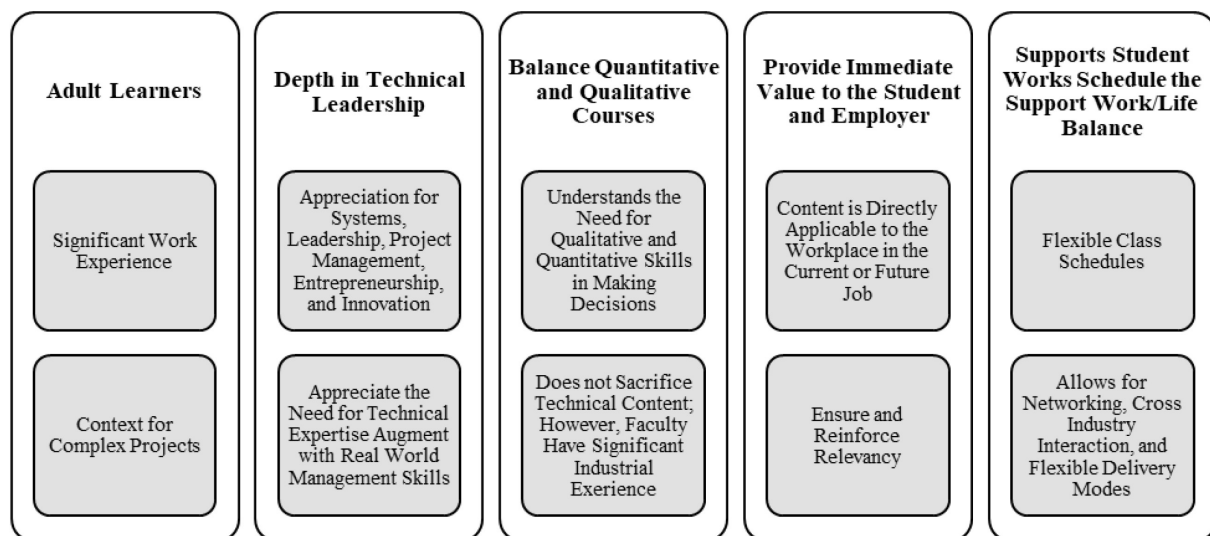


Fig. 2. Five characteristics of a professional engineering management program.

using the six components of assessment previously presented.

1. **Focus on both formative and summative.** For the formative assessment, the program measures the traditional skills development via assignments. These assignments were aligned to the program's objectives. The program also measures the professional development of the student and student ownership of the learning process. The students are asked to complete a series of papers to demonstrate their understanding of the important concepts presented in the course. In addition to the student learning the concepts, the program is focused on the student's applying what they learn to the workplace and also reflecting on their performance. The primary formative assessments are focused on individual reflections on what they learned and how it applies to the workplace. They are also assessed on their completion on a group project in each course. For the summative assessment, the program measures the program outcomes to improve course instruction and content. The summative focus helps ensure the delivery quality and program impact are positive and that student learning outcomes are being achieved. All program stakeholders (students, alumni, sponsors, professors, family, staff, etc.) participate in a series of assessment surveys and brainstorming sessions to evaluate the value of the program before, during, and after program completion.
2. **Use multiple assessment tools.** The program collects assessment data in each course, at the end of the program, and post-program. Fig. 1 maps the different assessment tools used in the program. We will next provide a short description of the tools.
3. **Understand the longitudinal impacts of the program by measuring before, during, and after the program.** The assessments conducted during the program participation focus on immediate application and impact. In addition to the immediate impacts, the program collects data from alumni. This alumni data collection helps understand the impacts on an alumni's job and career performance.
4. **Involve multiple stakeholders.** The program attempts to use multiple good measurement practices. For example, the program has integrated the net-promoter-score concept from customer satisfaction practices. Multiple stakeholders are involved in the assessment process.
5. **Ensure the assessment results are deployed for continuous improvement.** Closing the assessment loop is key to any assessment framework.

End of course and cohort reports are developed and shared with all stakeholder to include faculty and sponsoring companies.

6. **Provide evidence to employers and prospective students.** Evidence of program impact is more that improved student learning outcomes. Evidence must include tangible return on investment (ROI) for the program. We ask stakeholder to quantify the impact of the program on the employees/students taking in the program.

Fig. 3 portrays the integrated assessment approach across the program. As shown in the table, we are focused on assessing the seven desired educational objectives. Fig. 3 also summarizes the formative and summative assessment products across the program life cycle. We purposely have not included the details of summative assessment of student learning. The includes the details of exams, homework, etc. These are well understood.

3.2.1 Formative Assessment Approaches

Educational Objective: Be Clear on Workplace Practices

To ensure the students can reflect upon the content and apply the content to the workplace, we need the students to understand their organization and the skills they need to have to be successful in their unique environment. To meet this objective, we use four different approaches.

Organizational & Solution Delivery Challenges (Approach 1). The organizational and solution delivery challenges survey is completed at the start of the program. The student is asked a series of question to describe the current challenges their sponsoring organization is facing. These results are gathered and shared in company-specific working groups in the cohort. These results help define the overall context for the program and for what the students need to bring back to the organization.

Pre- and Post-Skills Assessments (Approaches 2 and 4). We use an assessment based on the intent of the program. The intent is to help our students become better at leading solution delivery teams. The solution delivery skills assessment is completed at the start and end of the program. This survey is focused on the sixteen core skills of solution delivery (i.e., the objectives of the program). The students are asked to define the importance of the skill area to their job. They also describe their current knowledge level for each of the areas. A gap analysis is then computed to determine the areas with the biggest gaps of knowledge needed versus knowledge have. The intent of the start of the program assessment is for the student to understand the areas the student needs to focus on during

		Program Life-Cycle			
Assessment Focus	Educational Objectives	Pre-Program	During the Program (Course-By-Course)	End-of-Program	Post-Program
Formative Assessment on Student Outcomes to Improve Student's Learning	Be Clear on Workplace Practices	1) Organizational & Solution Delivery Challenges 2) Pre-Skills Assessment (e.g., Solution Delivery Skills Assessment)	3) Specific Skills and Practices Assessments	4) Post-Skills Assessment (e.g., Solution Delivery Skills Assessment & Solution Delivery Roles)	
	Learn and Reflect on the Theory		5) "Coming in With" Paper 6) In-Class Exercises & Reading Reflections 7) Session Takeaways 8) "Leaving with" Paper		
	Apply to Projects		9) Program-Long Group Project with Oral Group Project Presentations 10) Application to Group Project—Company Specific Applications Ideas	11) Company-specific Project	
	Own the Learning Process	12) Reflective Paper on Program Expectations	13) Student Self-Assessment 14) Peer Assessment		
Summative Assessment on Program Outcomes to Improve Course Instruction and Program Content	Deliver a Quality Program		15) Course Assessment of Student Satisfaction 16) Start-Stop-Continue Group Discussion	17) Program Assessment of Student Satisfaction	
	Drive Impact for the Student and Sponsoring Organization				18) Alumni Survey (Periodically every 5 Years) 19) Sponsor Survey (Periodically every 5 Years)
	Evaluate and Adjust the Program	20) Closing the Loop			

Fig. 3. Summary of formative and summative assessment tools across the program life cycle.

the program. The intent of the end-of-program re-assessment is to see what gaps have been filled and what new gaps are created. This assessment is meant to help the student reflect on where they need to grow more. Analyzing this data is a challenge because students, especially in some of the management topics, often rank their pretest knowledge higher than in actuality. As they become more familiar with the material through coursework they often realize how little they know in certain areas. The post test results must be interpreted with this understanding. The solution delivery roles assessment asks the students to reflect on the roles a typical project manager play within their organization. The students complete this assessment at the end of the program in the EM capstone course. Students are asked to complete this assessment to understand and reflect on what they need to do in their organization. The students discuss the results in their company specific teams.

Specific Skills and Practices Assessments (Approach 3). In the program, we engage our students to complete assessments on specific skills related to the content in two courses: Project Management and Leadership. The “project management learning approach” assessment engages students to reflect on their daily project management practices. This assessment is partially based on the work of learning reviews. Students are asked a series of questions on the project management processes, tools, and behaviors they use to execute a project. Students can use these results to see how they need to adjust their approach. They discuss the

results in company specific working groups. The Kouzes and Posner [23] provides a robust 360-assessment tool on leadership behaviors. We use this assessment to help our students gain perspectives on their leadership skills.

Educational Objective: Learn and Reflect on the Theory

To ensure the students can apply a solid theoretical foundation to their daily practice, we focus our assignments on having them pull out the important learnings and how they can be used in the workplace. To meet this objective, we use four different approaches. For the reflective papers, students are asked to complete of series of papers.

“Coming in With” Paper (Approach 5). The first paper is the “coming in with paper”. This paper helps the student prepare for the course and asks the students to answer a few questions:

- What is your experience related to the “topic”?
- How does your organization use the “topic”?
- What positive impacts has the “topic” brought to my organization?
- What negative impacts has the “topic” brought to my organization?

In Class Exercises and Reading Reflections (Approach 6). To drive core concept mastery, we focus assignments in two areas: 1) reflective papers and 2) project application. According to [24] engineering alumni endorsed experiential learning and performance-based learning assessments. Moon [25] further elaborated on this cycle to argue that

experiential learning is most effective when the first step involves a “reflective learning phase” Throughout the course, the student will read a series of books and/or articles. Upon finishing reading the material, the student is asked to write a paper “reading reflection” paper answering:

- What is the “topic” challenge the reading discussed? (1 sentence)
- What is the “topic” opportunity the reading discussed? (1 sentence)
- What did I learn? (list of bullets with short explanation of each learning)
- How can I use what I learned in the workplace? (1–2 paragraphs)
- What new questions emerged? (list of bulleted questions).

These assignments are graded based on the completeness and depth of the discussion the student provides. The intent is for the student to understand the material and how it can be used to make a difference in the workplace.

Session Take Away (Approach 7). Most students retain only a portion of what is taught in a class. In order to reinforce what was taught at a higher level we ask each student to answer a quick survey at the end of every session and course. While still fresh in their minds this helps them think about relevancy for the material presented.

Leaving with Paper (Approach 8). At the end of the course, the student is asked to complete a “leaving with paper”. This paper helps the student pull the learning together by answering the following question:

- What are the most important learnings from the course?
- How can these learnings be used in the workplace?

These assignments are graded based on the completeness and depth of the discussion the student provides. The intent is for the student to understand the material and how it can be used to make a difference in the workplace.

Educational Objective: Apply to Projects

To ensure the students can apply their learnings to a real-world project, we have the students work in groups to complete a project. To meet this objective, we use three different approaches. The project application assignment focuses on the student working in a team to complete a project using the course materials. Each course has specific educational outcomes to be achieved. The project provides the opportunity for the student to apply the course materials to a project. The projects are evaluated for completeness and correctness.

Program-Long Group Project with Group Presentations (Approach 9). One unique aspect of the UCF program is the yearlong project. We mix students (i.e., commercial versus defense, private sector versus government, etc.) and require them to work on a yearlong project typical focused on some emerging technology typical at the systems level such as autonomous vehicles, smart systems, etc. The group project requires them to relate the material to a real-world application. Oral group presentations are meant to mimic real world presentations and are graded as such. Wellington et al., [26] provides a detailed discussion of the need for demonstrated skills and competencies that realistically represent problems and situations likely to be encountered in daily life, or where students are required to complete tasks that have real world applications (i.e., authentic assessment). This relates directly to student and employer perceived value.

Company Specific Application Ideas and Company Specific Project (Approaches 10 and 11). Another thing we do that is unique to the program is have the students develop a company sponsored project for the last class. This instrument helps to assess how students can integrated the various element of the SSD tools and processes. In addition to assessing student learning outcomes and how well they can be used to solve a real-world problem, this class provides visibility to the sponsors and helps build support for the program. From day 1, the students are told to start developing a project. Over the 2-year length of the cohort, some of the milestone for various homework are tied to the delivery of the final capstone project.

Educational Objective: Own the Learning Process

To ensure the students own the learning process we engage them in setting their expectations for the program and assess their performance throughout the program. To meet this objective, we use three different approaches.

Reflective Paper on Program Expectations (Approach 12). The reflective paper on program expectations is completed at the start of the program as a form of self-assessment. The intent of this assignment is for the student to explicitly define what they want and need to achieve by participating in the program. The student is asked to complete a paper answering the following questions:

- My Desired Outcomes
 - Why did I join this program?
 - What outcomes do I want to accomplish by participating in the program?
 - What knowledge and skills do I want to improve in myself?

- My Commitments to Myself
 - To accomplish my desired outcomes, what am I committed to do to support my learning?
 - To accomplish my desired outcomes, what am I committed to do to support my application of my learning to work?
 - To accomplish my desired outcomes, what am I committed to do to balance work-school-home life?
- My Commitments to the Cohort
 - To accomplish my desired outcomes, what am I committed to do to support my classmates in learning?
 - To accomplish my desired outcomes, what am I committed to do to support my in teammates in learning?

This assignment is to evaluate for completeness and meaningfulness of the response. The hope is for the students to review this “why” periodically throughout their participation.

Student Self-Assessment of the Learning Process Ownership (Approach 13). The student self-assessment of the learning process ownership is completed at the end of the course. The intent is for the student to provide a quick assessment of their engagement in a course. The student is asked the following questions:

- How well did I complete necessary prep work for every Application Session?
- How well did I participate in the discussions of the Application Session?
- How well did I participate in the work for the Program-Long Group project?
- How well did I participate in the work for the Corporate Application discussions?
- How well did I complete all of my assignments?
- Based on the effort I put forth in this class, I would say that I earned what grade?
- Based on the quality (e.g., depth of learning) of the products I put forth in this class, I would say that I earned what grade?
- To get the most value from this program, I need to start...
- To get the most value from this program, I need to stop...
- To get the most value from this program, I need to continue...

This content is reviewed by the program director to look for trends in engagement. This assessment was developed based on feedback from the students in prior cohorts.

Peer Assessment of the Learning Process Ownership (Approach 14). The student peer assessment of the learning process ownership is completed at the end of the course. The intent is for the student to

provide a quick assessment of their peer’s engagement in a course. The student is asked the following questions about each student in their project team. We use the simple “net promoter score” concept to capture your feedback on each team member and ask to consider the following elements when providing feedback such as:

- Quality of Work – The degree to which the student team member provides work that is accurate and complete.
- Timeliness of Work/Attendance – The team member’s timeliness of work. Showed up as scheduled, completed tasks on time, attendance at the group meetings, etc.
- Task Support – The amount of task supports the team member gives to other team members.
- Responsibility – The ability of the team member to carry out a chosen or assigned task, the degree to which the member can be relied upon to complete a task.
- Involvement – The extent to which the team member participates in the exchange of information and relates and communicates to other team members.
- Emotional/Motivational Support – Consider the amount of emotional/motivational support the member gives to other team members
- Leadership – Consider how the team member engages in leadership activities.
- Overall – The overall performance of the team member while in the group.
- Based on their performance during this course, how likely is that you would recommend this person to be on a project team? Why? What is the rationale for your answer?

This content is reviewed by the program director to look for trends in engagement. This is not graded. This assessment was developed based on feedback from the students in prior cohorts.

3.2.2 Summative Assessment Approaches

To drive program delivery enhancement, we focus on assessing the program in each course and at the end of the program. We also hold start-stop-continue discussions with the participants.

Educational Objective: Deliver a Quality Program

To ensure the program delivers a high-quality program, we conduct routine assessments on the delivery. To meet this objective, we use three different approaches.

Course and End-of Program Assessment of Student Satisfaction (Approaches 15 & 17). Satisfaction refers to the favorability of a customers’ subjective evaluation of the various outcomes and experiences associated with education [27]. Satisfac-

Table 1. Course and program level content and quality questions

	Course	End of Program
Overall Assessment	<ul style="list-style-type: none"> How likely is it that you would recommend the “course” to fellow students? Why? 	<ul style="list-style-type: none"> How likely is it that you would recommend the MSEM Cohort Program to your co-workers? Why?
Course Delivery	<ul style="list-style-type: none"> What is your overall level of satisfaction with this course? What is your overall level of satisfaction with the content of this course? What is your overall level of satisfaction with the instruction of this course? What is the level of satisfaction with the content covered in the course? What is the level of satisfaction with the instruction covered in the course? What is your level of satisfaction of the course materials? 	<ul style="list-style-type: none"> What is your overall level of satisfaction with the MSEM program? What is your overall level of satisfaction with the content of the MSEM program? What is your overall level of satisfaction with the instruction of the MSEM program? What is your overall level of satisfaction with the UCF staff support and overall logistics of the MSEM program? What is your overall level of satisfaction with the usefulness of the overall model driving the MSEM program?
Impact on Job Performance and Workplace	<ul style="list-style-type: none"> What is your overall level of satisfaction with the usefulness of this course on your job performance? What is your overall level of satisfaction with the impact of this course on our career advancement? What is the level of satisfaction with the usefulness of the course on your current job performance? What is the level of satisfaction with the usefulness of the course on your career advancement? 	<ul style="list-style-type: none"> What is your overall level of satisfaction with the usefulness of the MSEM program on your job performance? What is your overall level of satisfaction with the impact of the MSEM program on our career advancement?
Improvement Questions	<ul style="list-style-type: none"> How would you change the course? Start, stop, continue Please share any feedback on course content, materials, teaching style, or MSEM support 	<ul style="list-style-type: none"> What are the strengths and weaknesses of the MSEM program as offered to you and your organization? What should the MSEM program start, stop, and continue doing to deliver a high-performance program?

tion is one of the most commonly used measurements toward commercial services. Satisfied customers tend to be positive to the companies and have higher chances to introduce the companies to their friend. The same logic can also be applied to education [28]. Table 1 summarizes the questions used for both course and program level satisfaction.

Start-Stop-Continue Group Discussion (Approach 16). As part of our assessment process, we hold a brainstorming session with the participants. We hold this discussion at the end of each course. We ask the students:

- To help deliver a good course, what do we need to start doing?
- To help deliver a good course, what do we need to stop doing?
- To help deliver a good course, what do we need to continue doing?

This open-ended discussion offers real-time feedback and discussion. The students interact with each other and can provide deeper sharing than a typical survey allows.

Educational Objective: Drive Impact for the Student and Sponsoring Organizations

To ensure the program delivers a program that has

direct impact on the students and their organization, we conduct post-program impact assessments. To meet this objective, we use two different approaches.

Alumni Survey (Approach 18). Student value is different than student satisfaction. You can graduate from a program that is well designed and engaging yet contributes little to career advancement, mobility, etc. This type of program would have high student satisfaction but of little value other than simply learning. We attempt to quantify value by conducting alumni and sponsor survey every 5 years. Table 2 contains quantitative and opened questions that comprised the survey meant to assess former student satisfaction and perceived value and to make the students think about the benefits of the program. The open-ended survey questions are helpful to find specific examples, identify unique business cases, often provide specific examples that can be highlighted, etc.

This assessment instrument shown in Table 2 serves two purposes. First and foremost as an assessment tool to ensure that we are teaching the right content that students deem valuable. A secondary product is data that we can use to sell the program both to students and corporate sponsors.

Some faculty believe that higher education

Table 2. Alumni questions to assess student value

	Alumni Perspective
Overall Assessment	<ul style="list-style-type: none"> • What is your overall level of SATISFACTION with this course? • What is your overall level of satisfaction with the CONTENT of this course? • What is your overall level of satisfaction with the INSTRUCTION of this course?
Detailed Impact on Job Performance	<p>Knowledge Impact</p> <ul style="list-style-type: none"> • Based on your participation in the program, how did your knowledge and ability change? • What could we do differently to enhance the change in your knowledge and ability? <p>Use in the Workplace</p> <ul style="list-style-type: none"> • Based on your participation in the program, how often do you use the program knowledge in the workplace? • What could we do differently to enhance your use of the program knowledge on the job? <p>Job Performance</p> <ul style="list-style-type: none"> • How did your job performance change from before and after your participation in the program? • How did your boss's performance rating of you change from before and after your participation in the program? • What could we do differently to enhance the impact of the program on your job performance? <p>Career Advancement</p> <ul style="list-style-type: none"> • How did your participation in the program impact your career development/path? • What was your job title before you joined the program? What was your job title after you completed the program? • Based on your participation in the program, what were your expectations for a job promotion or increased job responsibilities? • What could we do differently to enhance the impact of the program on your career development? <p>Impact on Existing Projects</p> <ul style="list-style-type: none"> • How did your participation in the program impact the performance (e.g., cost, schedule, technical, customer satisfaction) of the existing projects you were working on? • Based on your participation in the program, what impacts did you make to an existing project? • Please provide a specific project example of where you had an impact using the knowledge you gained in the program. What is the business value (either savings or revenue) that you created? Please describe the impact of the change. • What could we do differently to enhance the impact on a specific existing project's performance? <p>Impact on New Business/Projects</p> <ul style="list-style-type: none"> • Based on your participation in the program, what impacts did you make to help gain new business for your organization? • Please provide a specific project example of where you had an impact by using the knowledge you gained in the program to gain new business. What is the business value (either savings or revenue) that you created? Please describe the impact of the change. • What could we do differently to enhance the impact on gaining new business? <p>Knowledge Transfer to the Workplace</p> <ul style="list-style-type: none"> • Based on your participation in the program, how often did you transfer the knowledge to your coworkers? • How did you share the program knowledge with your coworkers (check all that apply)? • What could we do differently to enhance your ability to share what you learned with others in the workplace? • Based on your participation in the program and your sharing of what you learned, how did your organization's capabilities (e.g., processes and tools) change? • Based on your experience in both your organization and the program, who else could benefit from participating in the program? • What could we do differently to enhance the participation by others? • What could we do differently to enhance the impact on your organization's capabilities?
Satisfaction with Impact on Job Performance and Workplace	<ul style="list-style-type: none"> • What is your overall level of satisfaction with the usefulness of this course on your job performance? • What is your overall level of satisfaction with the impact of this course on our career advancement?
Improvement Questions	<ul style="list-style-type: none"> • What are the strengths/weaknesses of the MSEM program as offered to you and your organization? • What should the MSEM program start/stop/continue doing to deliver a high-performance program?

cannot keep up with requisite skills needed in the job market. Instead, high education should focus on “providing students with the ability to think critically and laterally to solve problems creatively” [29]. However, if students cannot immediately apply the skills learned in a program the program is perceived of being of little value by both the students and their employers.

Sponsor Survey (Approach 19) – The sponsor use assessment is used to help understand the

needs, perceived value, and impacts on the sponsoring organizations. We ask one-two sponsors from each organization to complete the survey that is shown in Table 3. This survey is completed once every 4–5 years. Employers invest in post-secondary education for two reasons: (1) many employees consider it a part of the benefits package and needed to recruit and retain talent and (2) to provide employees with additional job skills that make them more productive contributors.

Table 3. Sponsor survey questions

	Sponsor Perspective
Overall Assessment	<ul style="list-style-type: none"> • What is your overall level of satisfaction with the following? <ul style="list-style-type: none"> – Program content – Instruction/instructors – Learning approach
Why the Program	<ul style="list-style-type: none"> • Why is being a solution provider important to making a difference for the world? • Why is the MSEM/PEM program important for making a difference for the world? • What is the one thing if your organization was better at this year it would fundamentally make a difference to your organization? • What type of impact is your organization intending for the MSEM program to make? • What challenges is your organization facing in making the strategy a reality? • Which of the following “leading strategically” challenges is your organization facing? • Which of the following innovation challenges is your organization facing? • In 7 words or less, how would you describe the value of the program?
Impact on Job Performance and Workplace	<ul style="list-style-type: none"> • What is your overall level of satisfaction with the following? <ul style="list-style-type: none"> – Participant use of the program knowledge on the job – The impact on participant job performance – The impact on participant career development – The impact on your organization’s existing project performance – The impact on your organization gaining new business – Participants sharing of the program knowledge with others in the workplace – The impact of participant’s sharing on your organization’s capabilities – What are 1–2 examples of where you have seen one of your employees (who is an MSEM graduate) make a difference in the workplace using what they learned in the program?
Improvement Questions	<ul style="list-style-type: none"> • What should the MSEM program start, stop, and continue doing to deliver a high-performance program?

Most employers will gladly fund professional master’s degrees that are relevant to their business. Some, to include the federal government, will fund relevant PhDs in order to have more qualified, productive, and renown employees. Like retirement and insurance, continuing education is considered a necessary benefit to recruit and retain talent.

Educational Objective: Evaluate and Adjust the Program

We are collecting a lot of data from the students and sponsors. We use this data to help us improve the program. To meet this objective, we use a “closed-loop” approach.

Closing the Loop (Approach 20). Assessment without a formal feedback process is simply of little value unless improvements are identified and implemented. Often called closing the loop, feedback based upon formative and summative assessment is key.

Analysis of the various assessment products combined with informal feedback are key to product improvement. In addition to the various surveys, we conduct discussions with the various cohorts after every class and at the end of the program. These informal sessions can be used to explore ideas, verify the results of the quantitative surveys, try to make sense of conflicting survey data, etc. Every 5 to 6 years (3 cohorts) we conduct a formal analysis across the program to look at trends. This has provided valuable insight and led to major content changes, faculty management,

workload balancing across classes, concepts of operations evolution, etc.

3.3 Return in Investment

The proposed methodology is complex and requires a major investment in class time and resources. All too often assessment is performed to meet accreditation and university requirements. Faculty usually believe that they know what is best. However, professional programs are different for many reasons to include:

- Usually, companies are paying the tuition and want to see ROI beyond a graduate degree being viewed as a benefit. Typically, these companies also provide employee release time and other resources to include technology. They want to have a say in content, ensure relevancy, and expect quality. Assessment is an important aspect of obtaining support from these companies. Closing the loop on feedback from employers is key to obtain customer’s feedback about their experiences with and expectations for your products/services.
- In most cases, students are practicing engineers. Industry in many instances are intellectual thought leaders. The students are using state of the art processes, software, systems, etc., in their daily jobs. They want to provide feedback about the content and delivery.
- Like any product you must have high customer satisfaction to have return customers. Assessment tools like self-reflection, coming in and

leaving papers are as much about assessment as they are to reinforce to the students what they have learned and how the subject matter content can be applied to their daily jobs.

- A robust and effective assessment system is an important and effective marketing tool. Providing quantifiable stakeholder or customer satisfaction is key to a successful academic program.

Closing the loop and improving quality is the overriding factor for assessment. However, a well-designed and robust assessment methodology is very important for stakeholder satisfaction.

3.4 Case Summary

We need to deemphasize the learning outcomes/objectives driven philosophies and focus more energy on stakeholder value. New forces in higher education requiring that universities evolve or be displaced in the market. Professional programs whether for degrees or simply training, are becoming a necessary component of a universities educational offerings. “Administrators are tasked with maintaining institutional financial solvency, which they accomplish by lending support to successful existing academic programs and services and by exploring and overseeing new academic ventures that have revenue-generating potential” [30] such as professional degree programs. Harvard Business School Professor Clayton Christensen consistently turns heads in higher education by predicting that 50% of colleges and universities in the US will close or go bankrupt in the next decade [31]. This will be a global trend.

Many programs will choose to use selective elements of the framework presented. However, we believe that in order to have an effective assessment framework we need to:

- Assess the student’s skills before and after the program. This will help provide direct assessment of learning and also gain insight into how valuable the student perceives the material.
- Measure the job skills not just in-depth engineering topics.
- Ensure students know this process – show in orientation and be specific on the intent.
- Automate as much as possible and place within existing learning management tools. This will help implement a consistent approach across all courses.
- Provide immediate feedback to both the students and the professors. This will help both the program and students to explore real-time the important feedback items. This allows for a deep dive on a specific issue while the experience is fresh in everyone’s mind.

- Shared with all stakeholders to include the companies that are paying for the program.
- Continue to evaluate and improve the measurement process itself.

We have presented a longitudinal 20-tool program assessment process that is both formative and summative and involves all participating stakeholders. We specifically did not present our assessment results but instead focused on the process. No one standard methodology is proposed. What is offered is that we must look beyond learning and some student satisfaction to justify our program to our stakeholders. We gave some examples of how this data could be collected. However, the most important aspect of this paper is that a new mindset must be embraced and to recognize that program quality evaluation is multi-dimensional.

4. Future Research

The training community has embraced integrated detailed assessment for many years. They need to do this not only for continuous process improvement but also for marketing. Research is needed in assessing stakeholder value and its importance, need for reflective writing, how to close the loop for a complicated assessment methodology, balance of outcomes/objectives-based assessment versus stakeholder value, etc. With most accreditation agencies focused on outcomes/objectives-based assessment, the value of an educational program, especially at the graduate needs to be quantified.

5. Conclusions

In many ways COVID-19 has contributed to the perfect storm in higher education where because of affordability, technology, and relevance; students, employers, and government are questioning the traditional academic model. Even before COVID-19, there was lots of evidence that disruption is taking hold in our universities. In order to remain connected and solvent, we must develop financially viable and relevant programs. Many universities have turned to professional education as a means to generate income and connect to their stakeholders. However, like any project we must serve our customers and assess our products with a focus on continuous product improvement. A robust assessment program is needed not only for continuous product improvements but also to articulate the value to all stakeholders. We believe the ROI is warranted for this type of comprehensive approach. The assessment methodology either in whole or in part provides a starting point for a comprehensive assessment program.

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